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MINUTES

73403

Forty-first Meeting of the General Advisory Committee
to the U. S. Atomic Energy Commission.

July 12, 13, 14, and 15, 1954
Albuquerque, New Mexico
and
Los Alamos, New Mexico

[redacted]

CLASSIFICATION CANCELLED
WITH DELETIONS
BY AUTHORITY OF DOE/OC
Carl Wilson 5/23/84
REVIEWED BY DATE
NR Schmidt 8/14/85

[redacted]

[redacted]

INDEX

Minutes, Forty-first Meeting, GAC

[redacted]

Weapons Briefings (Continued) Page

The engineering status of the external initiator was next described. The neutron source is the D-T reaction, tritium ions being generated and accelerated to a Ti-D target. The unit produces

External Initiators

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Significant size reductions have been accomplished, and the unit is now compatible with the MK-7 bomb. It may also be compatible with the TX-12.

Dr. MacNair said that the present units have one chance in 170 of not performing properly. This can probably be improved by selection of components and by potting procedures. The interim solution is to [redacted]

The present external initiators would require testing every 90 days. It is hoped that improvements will allow the tests to be put on a six month basis. The timing condensers require particular attention.

This initiator would present simpler testing problems in the stockpile than Tom, but more complicated [redacted].

In the question period the following points were brought out:

Compared [redacted] the external initiator has the advantages of (a) optimum timing, (b) simpler nuclear safeing problems, and (c) applicability to special assemblies, such as hollow spheres. The reasons for using it are thus entirely different from the reasons for substituting [redacted] longer shelf-life and simpler manufacture.

[redacted]

A program is coming along on nuclear safeing of high yield weapons; however the military requirement has not yet been formulated.

Considerable interest was shown in proximity and contact fuzes. The proximity fuze program is being pushed; it is hoped that 400 will be available for experimental purposes by the end of the year. The problems of contact fuzing two-stage weapons are great; one does not know how to do it at present.

This session was adjourned at 3:10 p.m.

THIRD SESSION
(July 13, 1954)

Los Alamos Briefings

The briefings were resumed at 9:05 a.m. in the S conference room at Los Alamos. Those present were: all members of the Committee except Dr. Wigner; the Secretary and Mr. Tomei; the other visiting groups (Appendix C); and members of the Los Alamos staff.

Dr. Bradbury opened the meeting by welcoming the visitors and introducing the LASL presentations.

Review of Castle

In the first talk, Dr. Graves reviewed the results of the Castle tests. He mentioned changes made during the tests: cancellation of the [redacted] shot in view of the high yields of [redacted] the firing of a modified [redacted] and the cancellation of the [redacted] shot at Livermore's request after the [redacted] shot. The following tabulation gives essentially final results as to yield and alpha of the various shots.

[redacted]

Predicted Yield	Total Yield (ball of fire)	Yield from fission (radiochemical)	Alpha Shake-1
4-8 MT	15 ± 0.5 MT		
1-7	11 ± 0.5		
1-6	7 ± 0.5		
ca. 11	13.5 ± 1.0		
ca. 2(1.7)	1.7 ± 0.3		
1-4	0.13± 0.03		

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The predicted yield listed for [redacted] was that made on the basis of the results of the [redacted] shot. The last two shots listed were made with a [redacted] the others with [redacted] The fission yields observed were in approximately the expected ratio to the total yields, except in the case of [redacted]

The time intervals in microseconds between detonation of the primary and [redacted] The figures in parentheses are those which were predicted before the shots.

Radiochemical fast neutron detectors (by n,2n) placed at various

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DOE ARCHIVES

Commenting on fall-out measurements, Dr. Graves mentioned difficulties in recovering the buoys and barges (after shot cancellations as well as after the actual shots) and said that he believed the best data would come from measurements made on the ocean water. (Mixing occurs in a turbulent surface layer of limited depth.) Fallout was sufficient to give an integrated dose greater than 400 r over an area of 5000-6000 square miles. The Navy wash-down system proved to be of great value on the vessels exposed to fallout. Dr. Graves believed that the integrated fallout from the barge shots was about the same from the land shots, but spread over a larger area.

Present Status TN Weapons

Next, Dr. R. E. Schreiber reviewed "the present status of weapons following immediately from the Castle operation". The following table gives the essential information.

	Type	Name (or next of kin)	Class	Weight (pounds)	Yield (megatons)	Status
	14-0		A-	32,000		Limited production. To be retired by Sept.30,'54
	17-0		A	42,000		In production.
	24-0		A	"		In production.
Current Weapons	17-1	DELETED	A	"	DELETED	Scheduled for stockpile entry Dec. '54. At that time production of 17-0 and 24-0 will cease.
	24-1		A	"		
	15-0		C	7,400		Stockpile entry ca. April '55.
	21-0		B	18,000		Stockpile entry ca. August '55.

[redacted] with normal lithium, which may have to be used, depending on the Oak Ridge production.

[redacted]

The class entries above refer to guidance descriptions established by the military, and have the following meanings, approximately.

TN Weapon Classes

Class A: weight 50,000 lb or less, minimum yield

B: 23,000 to be reduced to 15,000, " "

C: 8500 or less, " "

D: 3000 to 4000,

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The TX-14 has serious operational disadvantages, in that the assembly [redacted] as a ready weapon. [redacted] It is very cumbersome to assemble, and is quite expensive. Hence, LASL has recommended it be considered only as an interim device. Its components will be refabricated.

The [redacted] listed as 17-1, above, has some major engineering changes, from the Mod-0, which introduce new problems of fabrication from the weaponry standpoint. The main changes are:

(1)

(2)

(3)

(4)

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Dr. Schreiber, in response to a question from Mr. Winne listed the equivalent oralloy and Li6 costs of the various two-stage weapons as follows.

	Type	93.5% oy kg U235	37.5% oy kg U235	Li6D kg	Li6 enrichment
Equivalent Oralloy Costs	17-0*				
	24-0				
	17-1			DELETED	
	24-1				
	15-0				
	21-0				

*The 17-0 also uses DELETED

Each weapon also requires [redacted] 93.5% oralloy for the primary.

[redacted]

At this point there was a 20-minute break. The briefings were resumed at 11:00 a.m., at which time Dr. Carson Mark discussed "forward looking prospects in two-stage weapons".

Forward Looking Prospects in TN Weapons

Dr. Mark began by commenting on the fact that the yields of the Castle shots were substantially higher than predicted, in most cases. This is now understood in terms of nuclear reactions of lithium-7, which had formerly been assumed to be a much less good fuel than lithium-6 or liquid deuterium.

Li-7 as a Fuel

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Uniformity of Compression

Bomb
Weight

DELETED

Class
D Candi
date

Primary
Bombs

DELETED

Crossover
Class D
and
Boosted
Fission

[redacted]

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This session was adjourned at 12:15 p.m.

FOURTH SESSION
(July 13, 1954)

The briefings were resumed at 1:30 p.m. Dr. Bradbury introduced Dr. Duncan MacDougall, who talked on the development of tactical weapons of small size and yield.

Tactical Weapons

Dr. MacDougall said there were three sizes of warhead on the books to give [redacted] of nominal diameters 30", 22", and 15". Exact specifications in the military requirements still seem somewhat open. There seems to be no strong interest in the 30" [redacted] weapon, which could

be made now with existing techniques. Interest appears to be greatest in the 15" size for air-to-air rocket delivery, and in the 22" size for delivery by a device such as Talos W.

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22" Tactical Bomb	DELETED
Tactical Bomb Tests	
Thermonuclear External Initiator	

A [redacted]30" weapon can be made now, with conventional methods. If there were real interest on the part of the military establishment in a weapon of this size-yield characteristics considerable savings in

[redacted]

fissionable material could be accomplished relative to the smaller weapons. However the degree of such interest is not at the moment clear.

In a brief question period the following points were brought out:

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The next presentation was by Dr. Schreiber on the subject of nuclear safeing. He illustrated the problem by referring to a scaled-up DELETED It is assumed that any accidental detonation will occur at one point only, i.e. that the electrical safeing is completely reliable. The basic circumstance being worried about is crash on take-off, followed by fire. The following were given as possible criteria for nuclear safeing:

Nuclear Safeing

Safeing Criteria

(1) alpha is never positive;

(2) alpha does not become positive before the system disassembles, i.e. before about forty generations;

(3) the nuclear explosion resulting from a one point detonation should not exceed that possible with the normal HE load carried by the aircraft;

(4) "safety by probability", i.e. that the net estimate of the compound probability for the sequence of events leading to an accidental nuclear explosion be acceptably small.

Dr. Schreiber favored (3), as a workable criterion. It would require that the maximum accidental nuclear yield be less than about [redacted]. A calculation has been made for the [redacted] design on the assumptions that 40% of the normal energy goes into the heavy metal, the metal system preserves spherical symmetry, and the time of implosion is increased over normal by a factor 1.6 (inverse square root of E). The result of the calculation is that a 100 ton bang would result from one point of detonation, hence that the [redacted] is not nuclearly safe by this criterion. The assumptions of the calculation are conservative, however, and the accidental yield of the [redacted] would probably not actually exceed [redacted].

Safety [redacted]

Possible Nuclear Safety Test

Dr. Schreiber said that an experimental one point detonation test would probably be proposed eventually.

At this point there was a brief coffee break.

Improvements in the 30 KT Region

Next, Dr. MacDougall spoke on ideas for improvements in the 30 KT region. The present [redacted] has the following characteristics: weight 1600 lbs, yield about 30 KT, equivalent oralloy [redacted]

[redacted]

[redacted]. Tactical applications of this weapon would involve large numbers; it is therefore worthwhile to investigate what could be done to reduce the equivalent oralloy cost.

Recessed Detonators

Hydrodynamic Improvement Exterior Initiation

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Boosting

[redacted]

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Possible Tests

It is not intended to push these developments for a test of Teapot, but a test might be made in about a year and a half.

Weapon Use of Dirty Plutonium

If "dirty" plutonium (high 240 content) becomes cheap and plentiful through production in power reactors, it is of interest to consider how it might be used in weapons. Dr. Mark made a few comments on this subject.

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[redacted]

Dr. Mark mentioned that the Greenhouse Item shot [redacted] high pressure D-T gas) was detonated with a steady source, and gave [redacted] Dirty plutonium could obviously have been used.

After a few questions, Dr. Schreiber gave the next presentation, on the subject of the use of uranium-233

Weapon Use of U-233

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[redacted]

Dr. Schreiber emphasized that the figures for the two sizes were calculated on different bases and hence could not be directly compared (it is not valid to conclude that the [redacted]

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At 4:25 p.m. this session was adjourned.

FIFTH SESSION
(July 14, 1954)

The meeting began at 9:00 a.m. All members of the Committee except Dr. Wigner were present. The Secretary and Mr. Tomei were present. The other groups involved in the briefings were also present.

Test Programs

Dr. Graves gave the first presentation, on the subject of the test programs. After reviewing operational and safety problems, particularly as affected by weather, he outlined the thinking with respect to the next tests -- Teapot (Nevada, 1 March '55), Post-Teapot (Nevada, 1 September '55), and Redwing (Pacific, 1 March '56).

LASL will probably shoot in Teapot: [redacted], 16", 2 KT; [redacted], 22", 2 KT, [redacted] 22", [redacted] external initiation; a case test; and a booster test. There will be Livermore proposals, for a case study and for [redacted] Consideration is also being given to a group of shots proposed by the military: a 2 KT high-altitude (40,000 ft) shot for effects studies bearing on ground-to-air uses; a 15-30 KT tower shot for effects studies on drone planes; and a 1 KT underground (65 ft) shot, bearing on demolition applications. The Federal Civil Defense Agency has two

proposals, an effects test on shelters and an "open" shot (meaning open to large numbers of visitors). These will probably be combined with other tests. Dr. Graves remarked that it was a long list, with only limited possibilities for making combination shots. He said it was proposed to group together the shots of different organizations.

There are a number of possibilities for shots in Post-Teapot: 2-stage tests; one point detonation; predetonation; an optimized 30 KT [redacted] beryllium tamper; Li6D booster, or a gas booster; [redacted] a 30", 2 KT device. Dr. Graves said that a good predetonation or beryllium tamper experiment had not been thought of yet.

Redwing might include: a class D device, LASL; a class D device, Livermore; a class B weapon proof test, e.g. a 15,000 lb shortened [redacted] a class C weapon; and a high yield booster [redacted] (1/2 MT).

Wigwam, a proposed underwater test, 30 KT at 2000 ft depth, was also mentioned. The nominal date is 15 May '55.

There was some discussion on: operational problems in tests, fallout from air drops, the possibility of even larger, multimegaton shots, the importance (pro and con) of doing a good predetonation experiment.

At 10:40 a.m. there was a coffee break; the meeting resumed at 11:00 a.m.

At this time Dr. Bradbury delivered a critique on the philosophy of weapon design.

Philosophy of Weapon Design

From 1947 until 1954, Dr. Bradbury said, the country's thinking has been defined by a two dimensional array, of cores versus bomb sizes,

in which interchangeability of cores in bombs was a dominant feature. He expressed concern that this thinking -- "we don't know what we want to do but want to be able to do anything" -- is no longer relevant or appropriate.

Since 1954, the two-stage classes A, B, C, and D which have been set up cover the spectrum of yields and of vehicles in the thermonuclear field. In a number of cases they appear to render particular standard fission bombs obsolete. The MK-6 and MK-13, with weights corresponding to class C, are "dead ducks". Is anyone going to care about using a B-47 to deliver kilotons when 3 MT bombs of the same weight are available? Is the MK-5 worth carrying -- who prefers it to a class D weapon? The A to D classes appear to cover the strategic area.

Dr. Bradbury spoke for abandoning the array concept. He suggested, instead, additional classes to cover the tactical area.

"Class E" -- For fighter bombers, missile warheads, etc. This might be the size of MK-7, 30", weight 1600 lb and yield [redacted] Is this the proper size and yield to fix on for the particular purpose? The real point is to fix on a device with characteristics that people want, and then to make that weapon the best we can.

"Class F" — 30" (MK-7), 1600 lb, [redacted]

"Class G" — There might be two subclasses, G' and G'' in the 15-22" range, for air-to-air defense, anti-submarine use, missile warheads.

"Class H", etc. -- Gun types. So far all guns are interchangeable, which exacts penalties especially when one goes to smaller and smaller designs.

Dr. Bradbury emphasized that he was not proposing what the detailed class descriptions should be, but was proposing a philosophy, namely to fix on types in which large numbers are needed, to develop the best possible weapons, with the best achievable characteristics, of each type, without penalizing the design by requiring that the core be interchangeable with some other, i.e. strategic, weapon. The main tactical classes will require large numbers, instant readiness, and very wide deployment. Under these circumstances interchangeability is not relevant.

The gain to be achieved from abandoning the array concept could be an increase in the number of weapons by a factor of $1\frac{1}{2}$-$2\frac{1}{2}$, without the use of boosting. If one accepts the further specialization of boosting, the factors are probably larger still. If one clings to the concept of interchangeability, on the other hand, the further gains that can be made in the fission field are very limited.

There was an animated discussion following Dr. Bradbury's remarks. One point in particular was whether the gap between 30 KT and 1 MT was without interest. Opinions pro and con were expressed. No one present, however, voiced any dissent of principle with the changes in attitude proposed by Dr. Bradbury.

This session was adjourned at 12:05 p.m.

[redacted]

SIXTH SESSION
(July 14, 1954)

The final session of the briefings was devoted to Livermore matters.

Liver-more Brief-ings

The meeting began at 1:30 p.m.

After brief comments by Dr. E. O. Lawrence, Dr. Edward Teller reviewed Livermore's thermonuclear program.

[redacted] Analysis

Dr. Teller began by saying that [redacted] (giving 130 KT instead of the expected 3 MT) had been a very great disappointment. The reason for the low yield was [redacted] A great deal was to be learned from the test, however. To do so was all the more important because [redacted] in lighter and smaller TN weapons, as the [redacted]

Dr. Teller then proceeded to a detailed exposition of what had been learned from the [redacted] experiment. Some of the points were as follows.

[redacted]

[redacted]

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There was a coffee break at 2:55 p.m.

At 3:15 p.m. the meeting was resumed. Dr. York spoke about Livermore's small weapons program. Two lines were being pursued: [redacted] gadgets [redacted]; and [redacted] gadgets. Most progress has been made on the first.

Small Weapons, Livermore

[redacted]

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Characteristics of some various sizes were given as follows.

Diameter	Length, inches	Weight, pounds
7"	26	240
10"	36	
4.2"	16	50
5"		100
10"		
12"	42	800

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Possible Tests

A test shot program for this development has not yet jelled. The current thinking is to make one quite conservative shot (not a prototype) to be followed by a second shot.

Hydride Program

In the hydride program, Livermore was exploring the possibilities of substituting UH_3 for U metal.

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However, the situation was very uncertain. Various fabrication and handling methods are being investigated.

There were a number of questions and some discussion about the ideas Dr. York had reported.

This final session of the combined briefings closed at 4:20 p.m.

SEVENTH SESSION
(July 14, 1954)

The Committee met in executive session at 8:10 p.m. All members were present except Dr. Wigner. The others present were the Secretary and Mr. Tomei.

The topic of discussion was the aircraft reactor program, in view of:

Aircraft Nuclear Propulsion Program

(1) The comments in the Chairman's Report of the 40th Meeting (letter I. I. Rabi to Lewis L. Strauss, June 3, 1954, item 2) to the effect that the Committee was favorably impressed by the plan to marry the ORNL-Pratt and Whitney programs for the "fireball propulsion mechanism", had heard of the GE and NDA proposals, and suggested a study of the program as a whole to avoid unnecessary duplication and to sharpen the objectives.

(2) The request in the pre-meeting letter (H. D. Smyth to I. I. Rabi, July 9, 1954) for an elaboration of these comments.

Dr. Rabi asked whether he had correctly expressed the Committee's position in (1) and received assurances that he had.

Mr. Murphree remarked on some considerations by the Atomic Energy Panel of the DOD which had also felt a study would be in order.

Dr. Rabi asked Dr. von Neumann to set forth his understanding of current attitudes of the Air Force, in the light of his recent conversation with Mr. Zimmerman, head of the Operations Research Section of SAC. Dr. von Neumann responded with the following remarks.

Attitudes of the Air Force

(1) It is realized that the main mission is now anti-air force, e.g. destruction of aircraft on the ground, and not industrial destruction All else is secondary.

(2) There is great interest in large weapons.

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(3) The weapons which now exist can essentially fulfil their needs. The carriers leave much to be desired.

(4) They are very interested in contact fuzing, and unhappy that this is not receiving more attention.

(5) Ballistic missiles may become very important, but they will not supplant aircraft. At least one more heavy plane past the B-52 is needed. Nuclear propulsion is very much desired; it is considered more important than bomb development.

(6) The dispersion ideal would be about five planes on an air field. Considerable dispersion may be expected in the next 2-3 years.

(7) Speed may not be decisive in a heavy plane. High altitude may be more important.

There was a lengthy discussion on the proper attitude for the GAC to take with respect to nuclear aircraft development and its organizational arrangements. Most of the members were prepared to endorse the great urgency of this development. Mr. Murphree, Dr. Rabi, and Dr. von Neumann were particularly inclined to this view. Mr. Whitman, on the other hand, tended to take a more cautious position. He said he was in favor of a nuclear powered plane but was not convinced it should have first priority.

The Committee found no reason to revise its conclusions as expressed in the Minutes and Chairman's Report of the 40th Meeting. The present problem appeared to be one of emphasis, and of the best organizational arrangements for achieving the desired ends. It was tentatively decided that the Reactor Subcommittee would study the situation, and visit Oak Ridge and GE, before the next meeting.

The following two paragraphs convey an idea of the discussion which took place.

Dr. Rabi said that he had changed his opinion on the urgency of this development in view of the way the Air Force now understands its mission. He cited a discussion which Dr. Fisk and he had had with General Bunker on the need for a long flying air platform, one aspect being its possible use in very early warning. Long range rockets may not come in in time for the air field demolition missions. Mr. Whitman felt that one way missions would be inevitable, and therefore that chemically powered planes would serve. Dr. von Neumann said that it will be seven or eight years before intercontinental missiles furnish a slight retaliatory capacity, ten years before they supplant manned planes. Therefore another generation of manned planes is needed. Nuclear fuel will be an important supplement to chemical.

Dr. Rabi wondered whether the proposed organizational arrangements, involving Oak Ridge, GE, and NDA, really would give the best way to get the best effort behind a high priority program. Would a special organization set up for the purpose be more effective? He worried that a collection of little projects would tend to dissipate effort, and

would fail to concentrate enough push on the program. Mr. Whitman observed that the best Oak Ridge people were not on the aircraft reactor program; it seemed to be grudgingly carried because of the Laboratory's commitment. He did not feel that the program should take priority over the homogeneous reactor development at Oak Ridge. Dr. Rabi and Mr. Murphree disagreed, pointing out that Oak Ridge's responsibility is relatively much less in the power program than in the aircraft reactor program -- perhaps a fifth vs a half. Mr. Murphree felt there should be two, or perhaps three, concurrent developments; the art is still too fresh for the job to be left with a single organization. The responsibilities assigned to GE could not be taken away at this stage, but their effort might be pepped up. The Oak Ridge-Pratt and Whitney combination is a logical one. However, Oak Ridge is probably not going to push hard enough; perhaps the responsibility should be given to Pratt and Whitney. A third logical combination would involve NDA, with responsibility for experimental work assigned to one of the laboratories.

Dr. von Neumann left during the above discussion, at 9:00 p.m.

Distribution of GAC Minutes

After this discussion, Dr. Rabi brought up a matter concerning the distribution of the Minutes. The General Manager had asked whether they might be shown to Commission staff concerned with certain matters discussed by the Committee. Dr. Rabi had advised the General Manager not to do so, commenting that the Chairman of the Committee could not approve such a step without authorization from the full Committee. There was some discussion on this matter. The standing restriction on

distribution of the Minutes and access to them was felt necessary in order that the members should feel free to speak frankly and freely in their discussions, and in order that the record might preserve as much of the character of these discussions as possible. The Chairman's Reports to the Chairman of the Commission, on the other hand, are the property of the AEC; and their distribution is determined by the AEC. The Committee unanimously agreed to continue its standing restrictions on distribution of the Minutes and access to them -- and specifically, in the case in point, that the Commission staff should not have access to them.

This session was adjourned at 9:35 p.m.

EIGHTH SESSION
(July 15, 1954)

The Committee met in executive session at 9:05 a.m. All members were present except Dr. Wigner and Dr. von Neumann. The Secretary and Mr. Tomei were present.

Minutes of the 40th Meeting

Attention was first given to the Minutes of the 40th Meeting. Dr. Wigner had submitted a correction; this was accepted. Other members also had some corrections. Final approval was postponed until later.

Letter re Dr. Oppenheimer

Next, Dr. Rabi read to the Committee the letter which he had written on June 14 to the Commissioners on the case of Dr. Oppenheimer. Since it was necessarily semi-official because of his own position he felt it proper to ask whether the Committee wished it incorporated in the Minutes. Various expressions of approbation for the letter were made; the Committee agreed not to make it a part of the Minutes.

Next, the Chairman asked Dr. Libby for comments on the progress of Project Sunshine. Dr. Libby briefly reported that fallout over the continents from the Castle series had been very large, that it had not yet shown up in food and human samples. It was expected to show up in vegetation and food by Thanksgiving, and in humans by Easter. Rise by a factor twenty was anticipated. The project is under the AEC Division of Biology and Medicine. Dr. Libby has responsibility for food and human assays, Dr. Kulp and Mr. Eisenbud for fallout measurements

Sunshine Progress

At 9:30 a.m. the following persons joined the meeting: Mr. Strauss, Dr. Bradbury, Dr. Mark, Dr. Schreiber, Dr. Froman, Dr. Jane Hall, Mr. Quinn, Dr. Fine, and General Fields. Dr. von Neumann also entered at this time. Dr. Max Roy entered a few minutes later.

Dr. Libby went on to say that the subject was likely to become a matter of more and more urgency. The effort was being expanded somewhat; further expansion might be needed, depending on results which should be in by the end of the year. He said that ruthenium as well as strontium contamination might become dangerous in the region of 2-20 x 10^3 megatons.

Dr. Rabi then called on Mr. Strauss for remarks; the latter had none at this time.

The meeting was turned over to General Fields, who had asked to bring up the question of U-233 production.

General Fields reported that the Divisions of Military Application and Production had recommended to the General Manager, for approval on a planning basis, the large scale production of uranium-233. If

approval was granted, the immediate dollar costs would not be large, but instructions would be given to the duPont Company to look toward such production. Advance instruction was needed by duPont for their planning and process development.

The central reason for the recommendation is the

U-233 Productio Program

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The following production schedules have been proposed for consideration. Case A refers to no U-233 production, Case B to the proposed schedule including U-233.

Production through 1961

	Case A	Case B	Difference
Case A and Case B	DELETED		

[redacted]

	Corresponding Number of Cores	
	Actual No.	Effective No.
*		
**	DELETED	
***		

A value ratio of is assumed.

The effective number of cores is calculated on the assumption that

DELETED

At the suggestion of Dr. P. C. Fine, some figures pertaining to the steady state after 1961 were given. Advantages: (1) [redacted] /good TN weapons per year, (2) dollar savings of $30 million/year in processing costs. Disadvantages: reductions of [redacted] in plutonium production, [redacted] production. The first figure involves the value ratio of U-233 and plutonium; the second derives from the U-235 burn-up.

Dr. Schreiber said that the [redacted] relative value figure contained an assumption about the neutron velocity in U-233 which is somewhat uncertain. If Pajarito measurements are correct the velocity may be higher than assumed, and the relative value correspondingly higher.

Dr. von Neumann put the argument for case B as: the bookkeeping mainly shows that case B would not make a major upset in the thermonuclear program; for all other purposes case B provides an important degree of freedom.

Turning to Mr. Strauss, Dr. Rabi asked "why ask us, since so many advantages are evident?" Mr. Strauss replied that the advantages had previously not been so clear, and that in any case it was an appropriate matter for GAC consideration.

Dr. Libby inquired as to the certainty of the cost estimates. Mr. G. F. Quinn said that they were the best available, although it was true that experience was lacking in large scale thorium processing.

Discussion of Case B

Mr. Murphree asked whether there was a possibility that U-233 might have some disadvantage in weapons. Mr. Strauss said he had wondered about this and whether one should make a test before rushing into large scale production. Dr. Bradbury commented that a test would certainly be wanted, but that the low neutron background is definite

Possible U-233 Bomb Test

and U-233, which is intermediate between Pu-239 and U-235, can't do anything funny in a bomb.

There was some discussion, contributed to by Dr. Hall and Dr. Froman, about the neutron background. Impurity specifications would be about 5 times more rigorous than for production grade U-235. On the basis of U-233 in hand, which had been purified by the standard production processes, it appeared that the specifications could readily be met. Even if the impurity levels were 50 times those specified,

Impurity Specifications for U-233

[redacted]

Dr. Rabi asked what would be the effects year by year if the program were started in the immediate future. Mr. Quinn replied that: next January one Savannah reactor would be put on U-233 production, nine months later a second, and then a third. Operations would continue with three reactors on U-233 and two on low g/T plutonium, as controlled by the separations capacity.

Two years from now the thermonuclear requirement will be met by either schedule A or schedule B. The main differences are in U-235 and high g/T Pu. The present steps would be to approve duPont planning and to commit $35 million late in the fiscal year for plant modifications and construction. The duPont people anticipate no great difficulties. Dr. Rabi asked how upsetting it would be if one had to reverse the program later. Mr. Quinn indicated the main thing would be the conversion of the Purex plant back to its original functions.

Thorium Ore Supply

Dr. Rabi asked about the supply of thorium ores. Mr. Quinn indicated that the amount now available is sufficient for three years;

after 1957 a [redacted] per year would be needed. Several of those present commented that this was a more favorable situation than the one with respect to uranium ores.

Dr. Rabi inquired from Dr. Bradbury what arguments were against it. None appeared. Dr. Bradbury said that the strongest argument for U-233 was the increased degree of flexibility in weapon design. He would still advocate the proposal even if a bright idea developed which would greatly reduce the [redacted] The neutrons were not being thrown away; the added cost is not great; the weapon design and ore supply advantages are very considerable. To a question of Dr. Rabi's on possible effects on the Livermore progra he said it would give them another parameter to work with.

Dr. Rabi asked whether the larger critical mass would introduce [redacted] Dr. Mark said this consideration was already in the exchange rate.

Mr. Whitman said it would be a good thing to get a second raw material into the program. He also felt that the reactor program would probably benefit from this extension of technology.

Dr. Libby, who said he had been searching for an objection to schedule B, observed that it might remove the pressure from developing the technology of separating Pu-240 from high g/T plutonium. It was felt, however, that this was not too likely.

Dr. Rabi said his view was that the proposed step may be a good thing but is not likely to be of practical significance in the thermo-nuclear program. There will continue to be every incentive to improve

the primary -- [redacted] turns out to have been exaggerated.

Another advantage of U-233, pointed out by Dr. Fine, was that it would permit [redacted]

Further advantages were seen to be the lower toxicity of U-233 (Dr. Libby), and the related technological and fabrication advantages (Dr. Schreiber).

Interaction with Tritium Production

Dr. Rabi asked if the program would interfere with tritium production in case a requirement for that material came along. Dr. Hall said that tritium is made on the excess reactivity, that [redacted] of tritium will be available in FY 55, and that this rises to [redacted] /year. Mr. Quinn said that the changeover to thorium does not affect the tritium picture as it is now understood.

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Dr. Rabi said these arguments would make him perfectly happy if there existed a good theory for the yield. However, he would like to see another point on the curve closer to zero time, in order to check the validity of the extrapolation.

Dr. Mark said that the difficulties in predicting yields before the shots were not now relevant. The yields of all of the shots made — 40 to 50 in number, and in assorted configurations, etc. — can now be calculated well. There is every evidence that the calculations are sound, and no reason to think there is anything mysterious or interesting in the untested region of the yield curve. It is not clear what use could be made of a minor correction.

[redacted]

Dr. Rabi said that he could see a use from the customer end. There will be a lot of bombs of high g/T, and the military users would want to have solid knowledge of the spectrum of yields. He felt that military interest in such information about the stockpile might develop considerably.

It was pointed out that the two significant technical questions are (1) what is the probability that a neutron is present, and (2) given that, what is the yield. Dr. Bradbury favored a laboratory investigation of (1) for a period of about six months before returning to the question of a test shot.

Dr. Libby asked about the British report that the number of neutrons per fission has a wide spread. Dr. Mark said the report was that the number varies with the energy of the fissioning neutron. If the British paper is correct, the calculated [redacted] probability would be reduced to about [redacted] Dr. Taschek is planning some check experiments; they will take several weeks.

With these remarks the discussion [redacted] was concluded.

Dr. Rabi asked Dr. Bradbury whether there were any other matters he would like to bring before the Committee. There were none, and with the remark that it had been a superb briefing Dr. Rabi said that this part of the meeting was concluded.

Meeting with the Chairman of the Commission

There was a brief break. The Committee reassembled at 11:20 a.m., for a discussion with the Chairman of the Commission. Those present were: Mr. Strauss, all members of the Committee except Dr. Wigner, and the Secretary.

[redacted]

Mr. Strauss spoke at some length on the Oppenheimer case, referring particularly to the Commission's difficulties in maintaining its policy of no comment and to reactions to the Commission's decision, as manifested in letters and in the press. He expressed understanding for the feeling at Los Alamos. The fact that Dr. Oppenheimer's stand on the thermonuclear question had had no weight in the Commission's decision probably helped in regard to the Los Alamos reaction.

He mentioned that he was delivering a Presidential citation to the Laboratory on its extraordinary accomplishments.

Aftermath of the Oppenheimer Case

Dr. Rabi asked what would be the aftermath of the Commission's decision on the Oppenheimer case. Since associations had played such a prominent role in the case, there was considerable apprehension that a large drive overemphasizing associations as derogatory information would be made by security offices. Mr. Strauss assured the Committee that this apprehension was unfounded. Several Committee members remarked on the very grave morale problem in the Commission's laboratories which resulted from the case. Dr. von Neumann said that from a practical point of view this problem made it very important for the AEC to make clear its criteria of associations, particularly in view of the opinions recorded by Mr. Zuckert and Mr. Murray. Mr. Strauss indicated that the Commission would bring out in September a statement clarifying the security regulations.

GAC Opinions on U-233

Attention was next turned to the U-233 question. Dr. Rabi asked the individual members in turn to express their views for the benefit

of the Chairman of the Commission. The members responded as follows.

Mr. Whitman: We should go ahead with the proposed U-233 program.

Dr. Warner: Agreed. At the worst, we aren't losing much.

Dr. Fisk: It is essentially a stand-off in terms of numbers of weapons. The [redacted] has been bothersome. There is apparently a real gain. If decision is to be based on this consideration, it is essential to obtain the opinion of the military establishment. However, the flexibility argument, and the fact that it is not a significantly costly program suffice to support proposal B.

Dr. von Neumann: Agreed with Dr. Fisk. The nuclear situation contains many plus-and-minuses and the bookkeeping is very qualitative; but the gain in flexibility is very important. There are many advantages in chemistry and metallurgy. It is fortunate that the reactor situation is such that U-233 production can now be injected into the program with no major dislocations. As a secondary effect it will be of value in helping free us from bias and be more attentive to possibilities of what others, e.g. the Russians, may be doing.

Mr. Murphree: Was in favor. The program might have more advantages than can be foreseen at present.

Dr. Libby: Was completely in favor. Hoped the effort to purify plutonium of Pu-240 would not be set back.

Dr. Buckley: Did not feel qualified to give an independent opinion. Was always against more complications, but if there were a real advantage to U-233 would be swayed by that consideration.

Dr. Rabi: Was convinced in the meeting. No loss or long term disadvantages are involved, and no element of danger was discovered. The advantages of simplicity and flexibility are impressive. Strongly supported the proposal. (Appendix B, item 1)

Mr. Strauss inquired whether the opinions would be changed if it were found that the overall capability in number of crits would be less. Dr. Rabi said his own feeling of approval would continue as long as there were no short term disadvantage. A long term one could always be made up by building another plant. He would have opposed the proposal had it shown a short term loss, i.e. fewer weapons in '58.

U 233 Test Shot

Dr. von Neumann pointed out with emphasis that there should be a test shot; he would prefer [redacted] shot later. There was some discussion of the need for a test; and while the Committee wished to defer until later any specific recommendation for a U-233 shot at Teapot, it agreed unanimously that there should be a test as soon as practicable when a sufficient amount of U-233 is available. (Appendix B, item 1)

Brief consideration was given to the aircraft reactor program.

Aircraft Nuclear Propulsion Program

Dr. Rabi advised Mr. Strauss that the Committee would defer any additional recommendations until the Reactor Subcommittee had studied the matter further and had reported. He mentioned the Subcommittee's plan to visit Oak Ridge in September. Mr. Whitman announced that Dr. Wigner had been reached by telephone, and would be able to attend on the proposed dates of September 21, 22, and 23. (Appendix B, item 2)

Reactor Subcommittee Visit to Oak Ridge

At 12:30 p.m. this session was adjourned.

NINTH SESSION
(July 15, 1954)

The Committee met in executive session at 1:45 p.m. All members were present except Dr. Wigner, and Dr. Libby, who was absent from this session. The Secretary and Mr. Tomei were present.

GAC Discussion of Weapon Briefings

The Chairman called for views on the weapons programs as presented in the three-day briefing.

Sandia

Dr. Fisk, and others, remarked on the very great importance of the Sandia Laboratory. The time has come when the demands on Sandia should be determined by the mission of the Armed Services rather than by the potentialities of new weapons. The Laboratory, and what it represents, should grow more and more in importance relative to Los Alamos. The weapon philosophy arguments set forth yesterday by Dr. Bradbury were illuminating, and should be very carefully considered in planning Sandia's future efforts. Systems studies, in which Sandia

has a strong capability and a strong interest, are a prerequisite to what Dr. Bradbury is trying to do.

The Revolution in Weapons and the Growing Importance of Sandia

Dr. Rabi commented in this vein, saying that Dr. Bradbury's remarks had made clear the complete revolution which has occurred in atomic weapons. There will be very little resemblance between the situation two years from now and that two years ago. Dr. Rabi remarked on the maturity of the weapons art, the great prominence that systems engineering must now have, and its intimate relation to missions and to the stockpile. The duty of ensuring the most effective use of weapons, and of developing a general philosophy of weapon utilization will devolve more and more on Sandia.

There were several comments on the need for encouraging and utilizing Sandia's capability and interest in systems engineering. Some members had gathered that the new Area Manager was not providing such encouragement. There was some discussion of the matter. The Committee did not feel it would be appropriate to make formal comment at present; however it was hoped that ways would be found to encourage this vital work. The feeling was expressed that the Committee should manifest a lively and continuing interest in the work of the Sandia Laboratory.

Need for Encouraging Systems Studies at Sandia

It was remarked that the Sandia presentations were in general very good, although the weapon effect presentation was poor. The latter was probably a case of having misjudged the audience. There was also some disappointment about the to-do raised by Sandia on the difficulties of contact fuzing. However the significance of this was difficult to

judge in the context of the general situation on systems studies. (Appendix B, item 3a)

Los Alamos

Mr. Whitman said that the Los Alamos presentation was a very high grade job, and this seemed to be the unanimous feeling. Dr. Fisk added that, moreover, one gained an increasing feeling of strength and maturity in the Laboratory. Mr. Murphree said that Dr. Bradbury's proposal on weapon philosophy was a sound one. Dr. Fisk suggested that the Committee not attempt to judge that point of view now, but should call attention to it, to its real importance, and to the importance of examining it. (Appendix B, item 3b)

Livermore

The next subject discussed was the Livermore report. Dr. Rabi remarked, and Dr. von Neumann agreed, that the analysis of the [redacted] results had been a remarkable job of diagnosis. The Laboratory clearly has very capable people on its staff; it is unfortunate that they are not being effectively utilized up to their abilities.

Dr. Fisk said he felt the Committee could endorse the small weapon program. He was concerned, however, about Dr. Teller's 10,000 MT gadget and wondered what fraction of the Laboratory's effort was being expended on the [redacted] Mr. Whitman had been shocked by the thought of 10,000 MT; it would contaminate the earth. Dr. Rabi's reaction was that the talk about this device was an advertising stunt, and not to be taken too seriously.

With regard to the small weapons, Dr. Rabi said he had felt there was something very amateurish in the way the objectives were defined. The program was being set up without any study of how the war would be fought, what the planes and rockets actually would carry, etc.